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(54) Multi-algorithm lift control system

(57) A lift control system is adapted to operate selectively according to any one of several call processing algorithms in order to provide both direction collective two button control (up/down) and destination hall call control in which the destination is designated before the arrival of the lift. Manual control means capable of being modified to operate according to the selected algorithm may include a touch screen display (TD) with a software driven interface providing corresponding alternative video displays that indicate touch responsive areas of the screen that are appropriate to the algorithm in use. Therefore the control computer (CC) can be set to operate according to either algorithm, either manually, or automatically, in response to traffic demand.

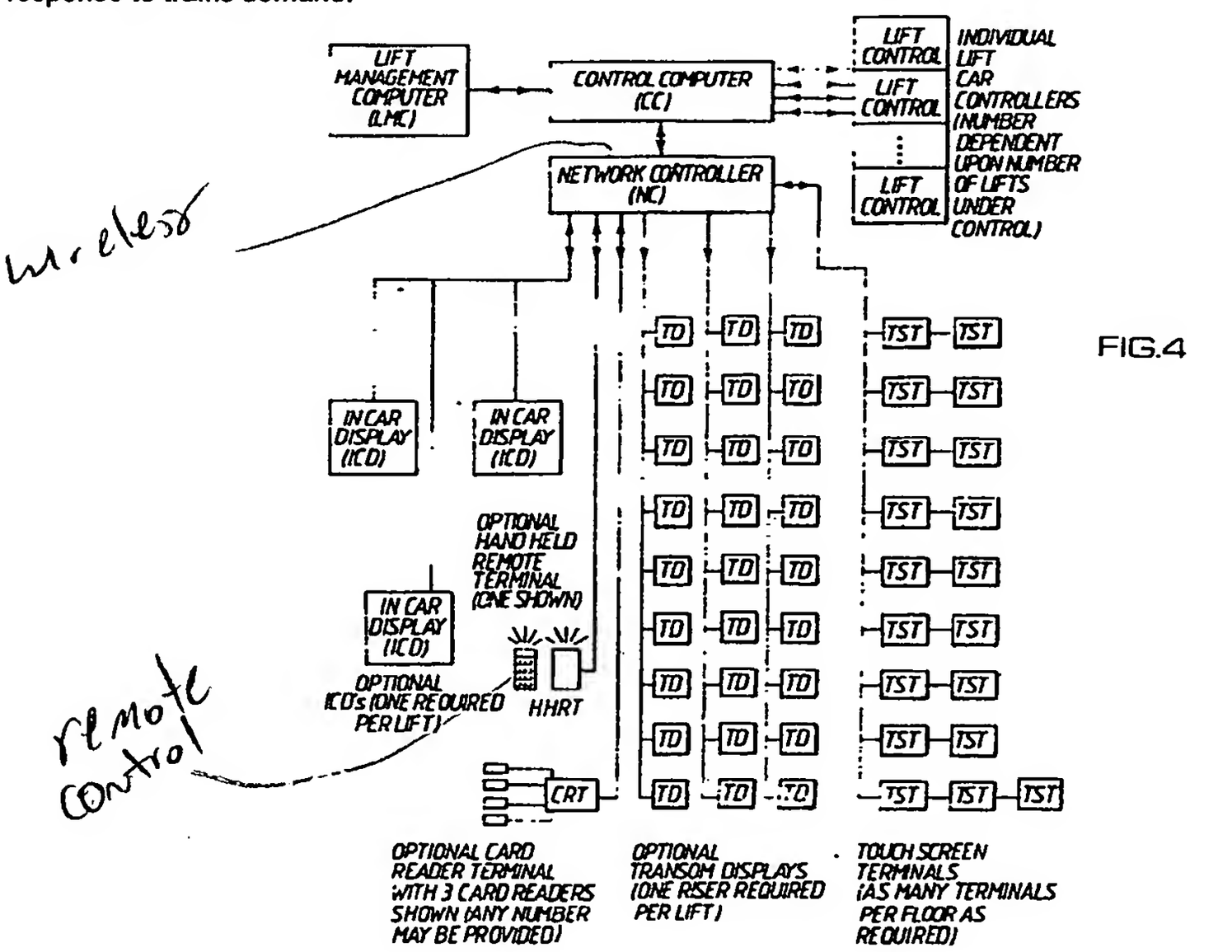

FIG.4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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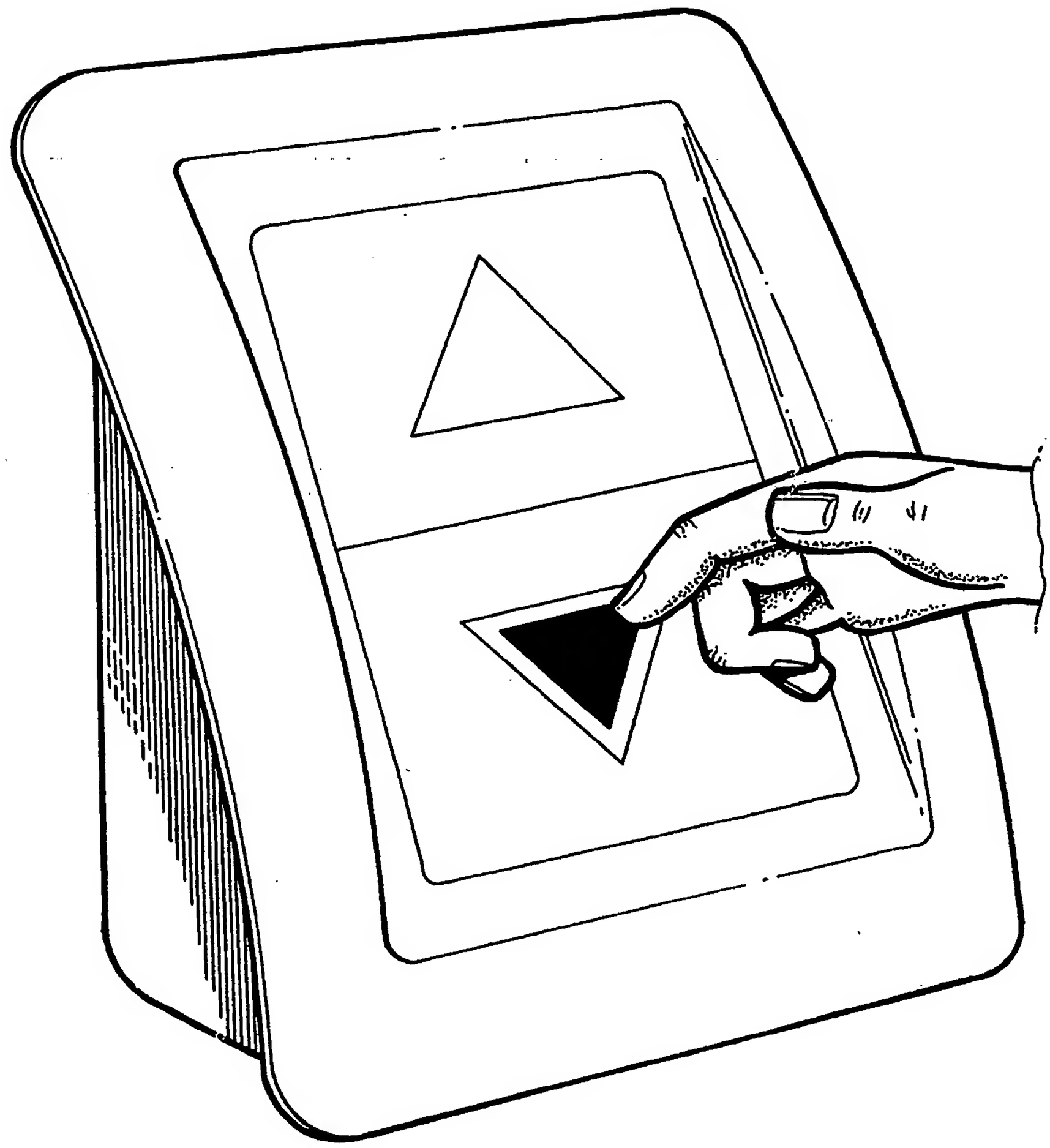

FIG.1.

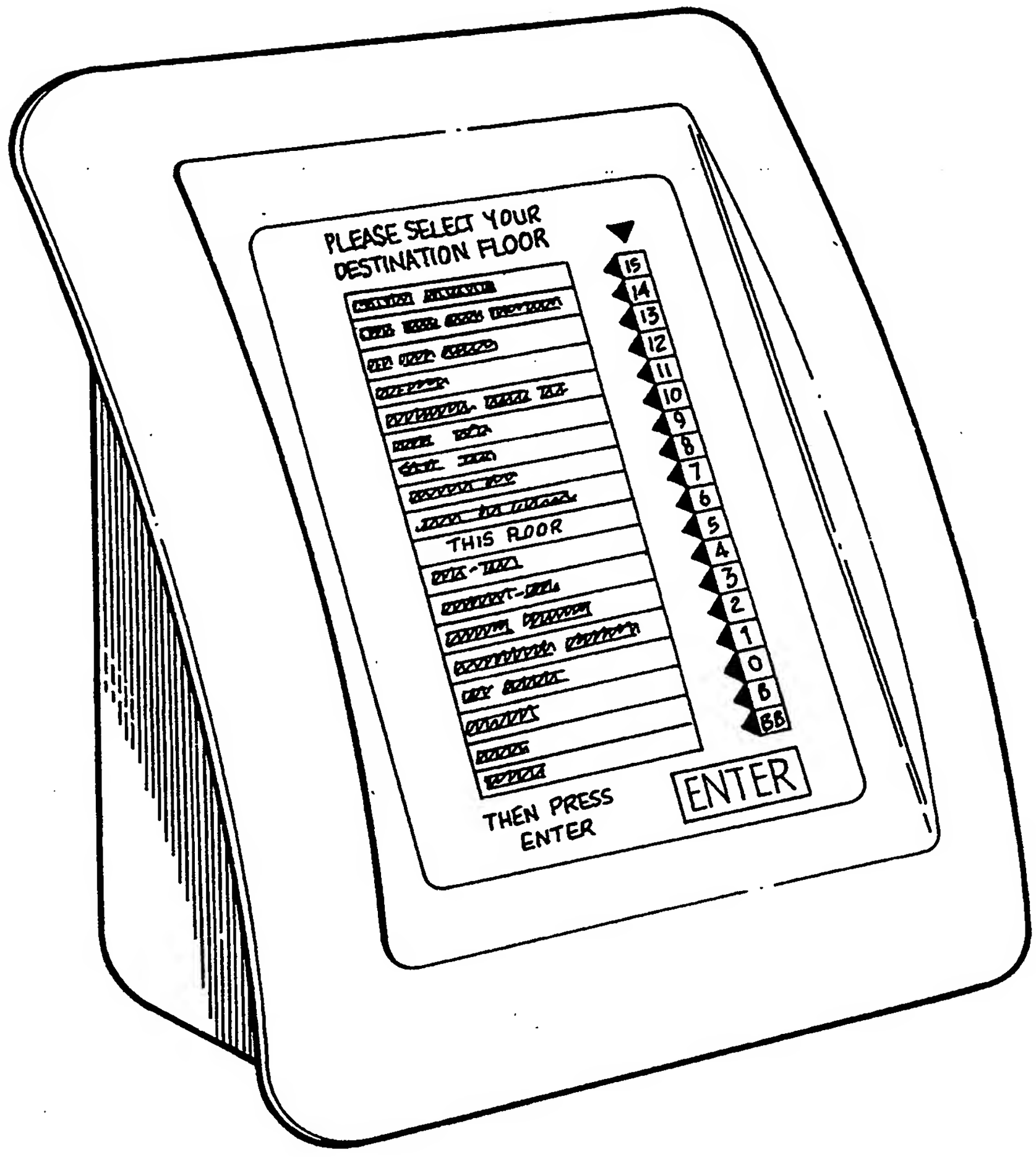
PLEASE SELECT YOUR
DESTINATION FLOOR
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FIG.2

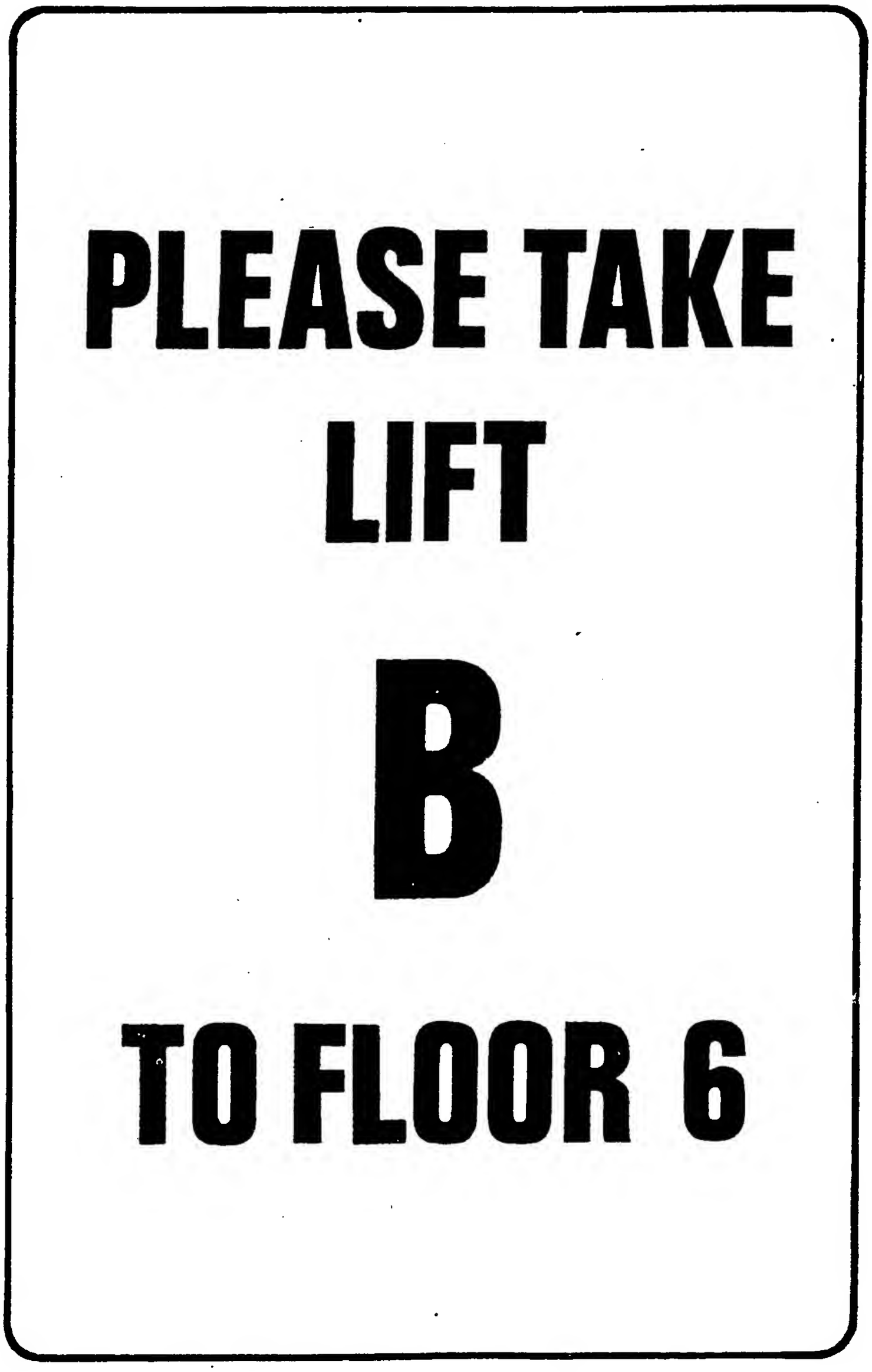

FIG.3

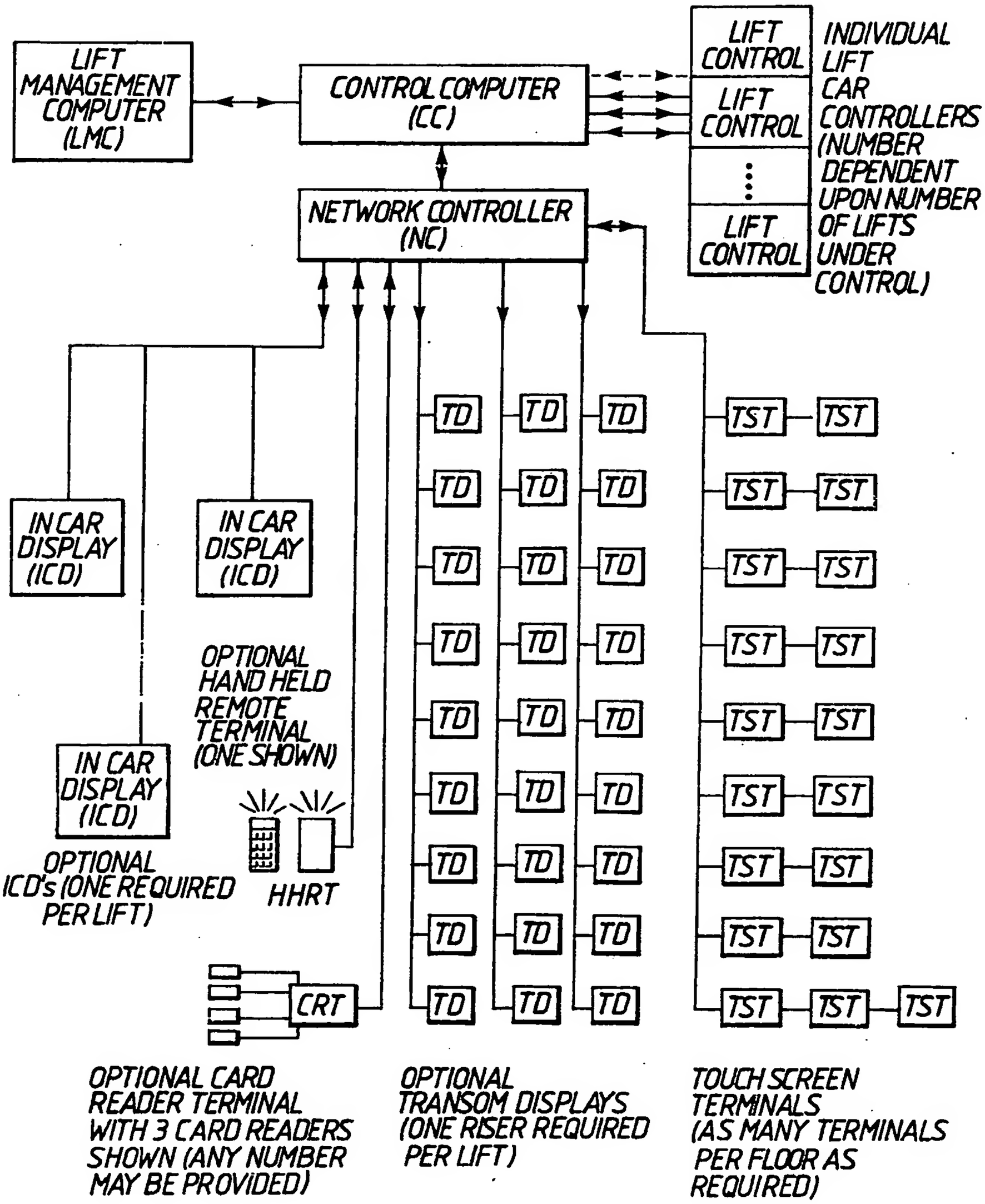
LIFT MANAGEMENT COMPUTER (LMC)
CONTROL COMPUTER (CC)
NETWORK CONTROLLER (NC)
LIFT CONTROL
LIFT CONTROL
LIFT CONTROL
INDIVIDUAL LIFT CAR CONTROLLERS (NUMBER DEPENDENT UPON NUMBER OF LIFTS UNDER CONTROL)
IN CAR DISPLAY (ICD)
IN CAR DISPLAY (ICD)
IN CAR DISPLAY (ICD)
OPTIONAL ICD's (ONE REQUIRED PER LIFT)
OPTIONAL HAND HELD REMOTE TERMINAL (ONE SHOWN)
HHRT
CRT
OPTIONAL CARD READER TERMINAL WITH 3 CARD READERS SHOWN (ANY NUMBER MAY BE PROVIDED)
TD
OPTIONAL TRANSOM DISPLAYS (ONE RISER REQUIRED PER LIFT)
TST
TOUCH SCREEN TERMINALS (AS MANY TERMINALS PER FLOOR AS REQUIRED)

FIG.4

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IMPROVEMENTS IN AND RELATING TO PASSENGER ELEVATOR OR LIFT CONTROL SYSTEMS

This invention concerns improvements in and relating to passenger elevator or lift control systems.

Traditionally users of lift systems have registered their demand for lift service using a simple 'push' or call button in the lift lobby. In commercial and institutional premises, amongst others, it has been customary for users to register their demand and their intended direction viz. up or down on one of two buttons.

For many years the lift industry has attempted to provide a system that enables users to actually register their destination floor from the lobby. This has been attempted using rows of pushbuttons, keypads etc. with a greater or lesser degree of success. The importance of gaining information on the users' ultimate destination, prior to assignment of a lift car to collect that call, should not be underestimated. The lift resource can, undoubtedly, be far more efficiently used if the numbers of persons waiting for service at each floor as well as their destinations are known. Ultimately this means less lifts required to service a building, less capital cost and space savings for owners. The lift industry continues to develop such "call allocation" or "destination hall call" control systems in an attempt to realise their true potential.

Hitherto however, it has not been possible to realise the potential of both the traditional two button arrangement as well as that of the "call allocation" or "destination hall call" control systems.

It is accordingly an object of the invention to alleviate the above-mentioned disadvantage.

The invention accordingly provides a lift control system including means for receiving and for processing calls for lifts from users of the system, in order to allocate lifts for movement to given destinations, said call processing means being adapted to be set selectively to operate according to one of at least two call processing algorithms including a directional collective control algorithm and a destination hall call control algorithm.

Because of the flexibility of the system according to the invention, traffic control strategies, or algorithms, can be instantaneously changed or modified either manually or automatically and even run simultaneously with respect to different levels of the building. The benefits of the different control strategies can therefore be obtained at the appropriate times and according to the circumstances prevailing, i.e. traffic/user demands.

The particular call processing algorithms that may be incorporated in a system according to the invention are known per se, and for further particulars reference may be made to "Elevator Traffic Analysis Design and Control" Revised Second Edition by G.C. Barney and S.M. Dos Santos published by Peter Peregrinus Ltd. on behalf of the institution of Electrical Engineers.

Preferably, said means for receiving calls for lifts includes two alternative sets of manual controls enabling a user to place a call by indicating, on the one hand, a required direction of travel, or, on the other hand, a destination served by a lift, and wherein

said lift control system includes means responsive to the selected setting of said call processing means for indicating to a user that set of manual controls that is available for use.

Advantageously, said manual controls comprise touch responsive areas of video display screens, and said responsive means is arranged to display on corresponding screens, selectively, any one or more of a plurality of video images depicting appropriate touch responsive areas of a video screen.

Because the contents of the screens and their operation can be changed in an instant this enables the control system to adapt to traffic demands, building managers' requests etc. to operate in either the two button (up/down) mode or the alternative mode of destination touch buttons on the same device.

The invention is illustrated by way of example in the accompanying drawings, in which:

Fig.1 is a perspective view of a manual control device for use in a system according to the invention, shown in one mode of operation;

Fig.2 is a view similar to Fig.1 showing the device in another mode of operation;

Fig.3 is a front view corresplonding to Fig.1 showing the device in a message display mode; and

Fig.4 is a block diagram of a lift control system according to the invention.

Referring to the drawings, Figure 1 illustrates the

touch screen peripheral operating in the two touch button mode. Figure 2 illustrates how the same device is used to present an array of destination touch buttons to the user. Figure 3 illustrates how the screen responds to a call being placed on it using the destination touch buttons mode of operation. Because of the new flexibility it is possible, for example, to take the accepted benefit of better traffic handling during periods of up peak traffic, i.e. many people arriving at the main floor of a building over a short period of timne, of the "destination hall call" approach but use the "two button" operation on the same touch screens for the remaining levels of the building. Similarly during heavy down peak the touch screens can all revert to "two button" operation from "destination hall call" to enable the greater efficiency of two button operation under such traffic conditions.

The high resolution flat screens used are commercially available devices that use LCD (liquid crystal display), plasma or electroluminescent display technology. They consist of two parts. Firstly the display itself which can be liquid crystal, gas plasma or electroluminescent e.g. Planar Systems Inc. Part No. EL8358HR which is a 125 mm by 200 mm size display and secondly the touch screen overlay device which produces a series of infra red beams across the surface of the screen which can be broken by a finger and thus detected as a system request by a user. A typical device for the above display would be the Caroll Touch Model No. 8001-4243 V01. A standard touch screen overlay with its sensor sytem is placed in front of the flat screen with a toughened laminate or clear plastic protective window used to protect the display from abuse. Of the display technologies available

electroluminescent is by far the best choice, if not currently the cheapest, since it offers high brightness, wide viewing angle and a faster update rate than LCD technology.

The multi-algorithm traffic control system can be used with either new lift installations or "added on" to existing lift systems in a process known as an "overlay". The control system is thus particularly attractive to owners of buildings whose lift users experience long waiting times because of an apparent or real lack of lift resource to deal with the level of traffic prevailing.

The control system consists of a number of devices arranged as a total system. Some devices are optional according to customers' wishes.

The primary devices are known as the touch screen terminals (TST), the control computer (CC) and the network controller (NC), the secondary (optional) devices are the transom displays (TD), the in-car displays (ICD), lift management computer (LMC), card reader terminals (CRT) and hand held remote terminals (HHRT).

Figure 4 shows a block diagram of the system outlining the system architecture. An integral part of the proposed design is the use of a network to connect all the devices to the control computer. The main features of the design are its modularity - each device is an independent unit and there are no inherent limitations on the control system in terms of numbers of lifts, floors served, devices per floor etc. The devices connect together and communicate via a simple local area network thereby reducing cabling costs and

allowing a degree of fault tolerance, viz. the failure of an individual device does not lead to widespread system failure. The network design also allows fault monitoring to take place since each device is continuously monitored and the control computer (CC) will log all detected faults to facilitate maintenance. All the devices have an identical network interface and connect to the CC in exactly the same way. The use of a uniform network allows devices to be added at any time and indeed new devices as and when developed. The choice of network is incidental to the design but the prototype system uses an RS422 physical layer with a data link layer based on HDLC Normal Response Mode. Transmission is over a shielded single twisted pair cable.

Arbitration of the transmission medium between the different devices connected to the network is performed by the network controller (NC) which sends a message to activate the transmitter in a particular unit. This fits in naturally with the proposed protocol in which the control computer (CC) sends commands to the different devices and polls them for status information (i.e. the NC must in any case send a message to the next active transmitter). A timeout implemented in the network hardware prevents a faulty network device from jamming the network.

As well as reducing cabling costs, the use of a single cable readily allows support for broadcast messages to all or a specific group of network devices and also allows network devices to monitor the replies of other network devices.

Two physical networks are proposed in order to simplify the cabling arrangements: one is to link the CC to the

TST's and the TD's and the other to connect the CC to the ICD's. A third network may be added to support the CRT if required. The use of RS422 with its balanced drivers and receivers gives both better noise immunity and higher potential data rate than a single ended transmission scheme.

It is not proposed to comment in any detail upon the control computer's software since the control algorithms adopted, i.e. the manner in which lift cars are assigned to landing calls, as this is already well documented by others. The novelty of this control system is its ability to run more than one algorithm by simply driving the touch screen terminal (TST) in the appropriate manner. Likewise the control computers' interface is simple being either universally accepted data communication links to a microprocessor system controlling each lift or in the case of relay based systems a hardware interface whereby the lift cars can be driven to the requisite floors by the placing of landing or car calls on each lift by driving pairs of electrical contacts. Likewise the feedback of lift position is either via the same data link or pairs of input electrical contacts to the control computer (CC) of the floor position of each lift at all times.

The control computer (CC) polls all the peripheral devices on the network and can therefore determine any faults on network peripherals quicky and accurately. The control computer is built in duplicate both in terms of hardware and software such that if one unit fails its duplicate back-up will take over. This is important as the control computers' continued operation is critical in maintaining lift service. A final back-up resident in the control of each individual lift allows for a "bus stop" form of operation if the

control computer is subject to complete failure.

As already mentioned above, it is a feature of the invention that the lift control system can operate selectively according to the "two button" or directional collective control algorithm or the destination hall call algorithm. The control computer can be set to operate according to either algorithm, either manually by means of an appropriate manual control means available to building management, as described below, or automatically, in response to monitoring of demand, or potential demand on the system. In order to effect automatic control the lift system includes means (not illustrated) for sensing that direction of travel for which demand for the system predominates. Thus, for example, the departure of several lifts in succession from a main lobby can be sensed by load weighing equipment on each lift or crowd sensors scanners in a lobby or on a landing could be used to detect the presence of passengers waiting for transport.

When, by means of the abovementioned sensors and/or by processing calls already placed via the touch screen terminals, the control computer determines that the predominant demand is for transport in the upward direction from a main floor of a building it will switch to the destination hall call mode, whereas when the predominant demand is for downward transport from several floors it will switch to the "two button" mode. It will be appreciated that the control computer will be programmned appropriately to avoid instability when the demand is evenly balanced or subject to rapid fluctuation.

When operating in the "destination hall call" mode the

touch screen terminal (TST) elicits the required destination from user, exchanges a series of messages with the control computer (CC) and then displays to the user the lift that has been assigned to them. Having displayed the lift assigned to collect the user the screen reverts to the normal floor selection display, usually after a couple of seconds. N.B. It is normal practice to place suitable reference signs alongside or above each lift entrance indicating to users the identity or reference number/letter of each lift. This is in order that when the system operates in "destination hall call" mode the user is in no doubt which lift he has been told to enter to complete his journey.

When operating in the "two button" mode the touch screen terminal (TST) displays two direction arrows in outline and as either is touched by the user the control computer (CC) accepts the call and highlights the arrow to indicate call acceptance.

The number of touch screen terminals placed in any given lobby is not limited. It is suggested that the number of such units be sized according to the peak levels of traffic that the lobby is likely to encounter.

During most of the time the control computer (CC) is polling the TST's, ICD'S, HHRT's and CRT's for service requests, i.e. user call registrations. The control computer (CC) produces commands both to drive the lifts to the appropriate floors and to present the necessary information on lift assignments, call registration or committed car stops on the TST's, ICD's, HHRT's or TD's.

Incidental to the use of the touch screen terminals (TST) is a number of useful functions for the user. Firstly, the user may be presented with a form of building or floor directory to assist him or her if they are uncertain as to their destination floor. Secondly, in the event of the touch screen terminal (TST) being used abroad or in the home country where tourists or foreign visitors might be present, it can offer the user a translation of the floor directory and the process of call registration itself. The translation facility is provided by using a portion of the touch screen for requesting language translation. The normal display may revert to English language after a preset period if required. Because the touch screen terminals (TST) are software driven they could also be used to display messages of all types to building users. To conserve display life the touch screen terminals (TST) may have a passive infra red detector fitted that turns on the display as a user approaches it automatically. Also by the use of a coded sequence maintenance engineers and others may switch the touch screen terminal into another mode of operation whereby information about the status of each lift and the calls registered at different levels may be viewed and interaction with the control computer (CC) established.

The network controller (NC) is an industry standard processor card whose purpose is to control the communications process throughout the network and pass input and output information to the control computer (CC).

The optical devices can be described as follows. The transom displays (TD) can be located above each lift entrance at all or any floors as required. When the

control system is operating in "two button" mode these units, again consisting of a flat screen display, can display an up or down arrow together with an electronic chime or annunciator in a similar manner to a traditional hall lantern and gong on most present day lift installations. When in the "destination hall call" mode the displays indicate a subset of floors that the lift is committed to stopping at after that floor at which the user is present. If the lift is not committed to stopping at that floor then the display will remain blank. Its most useful feature, in this mode of operation, is that it allows persons who have just entered the lift lobby to board a lift car knowing it is committed to stopping at the floor they require without having registered their call. For the user who has already registered their call it provides reinforcement of the commitment of the lift, that has been assigned to them, to stop at the floor they require. Another useful feature of the transom displays (TD) is that they can be used to inform users of when lifts are "OUT OF SERVICE", "ON GOODS SERVICE" etc. by displaying the appropriate message in plain text form on each transom display (TD) used at each floor for a particular lift. The transom displays are arranged in a write only subnetwork of the control system.

The lift management computer (LMC) enables the building manager, the maintenance company and others to interact with the control computer (CC) and to store and display the ongoing performance of the lift installation.

The menu of commands and facilities available on the lift management computer (LMC) are numerous but include analysis of faults on the network, journeys

performed by each lift, detailed analysis of waiting times in response to landing calls, analysis of traffic demand in the building, automatic notification of faults via modems to the maintenance company, analysis of lift system faults, analysis of lift status changes etc. The LMC may also be used to change the description or format of the touch screen terminals at each floor, for instance if a department relocates to a different floor etc. The data link of this device to the control computer (CC) is a universally accepted serial link.

The next option is the in-car displays (ICD) which consist normally of two flat screen displays, one of which has a touch screen overlay. The first display is used to inform passengers of the lift's position, and in the "destination hall call" mode, of the floors that the lift is committed to stopping at. Because, once again, it is software driven it may also be used to display messages of any type which may be input and stored on the system via the lift management computer (LMC). The second display is used as follows:

When in the "destination hall call" mode the display remains blank (unlit) except if the lift is required for "goods service" when, upon insertion of a key in an adjacent keyswitch, the display will produce an array of touch buttons in order that the attendant can remove the lift from normal service and drive it to the floors required. When the lifts operate in "two button" mode the destination floor touch buttons become available to all users and calls are registered by touching the appropriate area of the screen whereupon the destination floor legend is highlighted and the call accepted. Another option on this control system, as already mentioned, is the hand held remote terminals

(HHRT). These devices are similar in appearance to the now ubiquitous TV remote controls that people use to change channels etc. on their TV sets. This hand held device works on the same principle but has a two-way communication link with a processor-based terminal located remotely and wired in to the local area network. The primary features of the hand held remote terminals (HHRT) are as follows:

The device is battery powered and hand held. It enables the person using the device to book calls on the lift system, at the floor it is used, standing at any point in the lift lobby. The device responds in a similar way to the touch screen terminals, which are wall or floor mounted, by telling the user which lift has been assigned to collect that call. Other buttons, apart from a keypad for floor destinations, enable users to hold the doors on any lift e.g. for the boarding of disabled persons, to indicate heavy demand for a particular floor, e.g. coach party just arrived in foyer of building, all wishing to travel to the third floor and to make a lift available for goods/independent service when required. The main attraction of the HHRT is for a "lobby operator" to provide personal service to visitors and users of the lifts in general. In this respect the HHRT also has a "Priority" button to get assigned and obtain a lift quicker than would normally be effected. This can be used for the benefit of VIP visitors etc. to a building.

The HHRT communicates via infra red signals to a receiver/transmitter mounted in the ceiling of the lift lobby which is connected to a micro-processor system mounted remotely somewhere and wired into the local area network. From a viewpoint of the network as a

whole the HHRT is just another peripheral and is communicated with in the same way as the other peripherals on the network.

The final optional device that can be connected to the network is the card reader terminal (CRT). This unit, which would normally but not exclusively, be located at the main terminal of the lift system consists of the following:

The unit is a micro-processor based terminal which can support up to ten magnetic card readers. The purpose of the unit is to read a card carried by the user as he is about to enter the lift lobby and pick off his or her normal destination floor and make a booking for the user for that floor with the control computer. The control computer will then display on the transom displays (TD) at the main terminal which lift has been assigned to take them to their floor. It should be noted that the card readers can be used in either the "two button" or "destination hall call" mode. In the latter case the destination floor will be used by the control computer, in "two button" operation the control computer will just gauge the numbers of persons entering the lobby. In the case of the lobby being the main terminal at the ground floor or equivalent of a building it will know precisely what the up peak demand is minute by minute.

If, under "destination hall call" control the user does not wish to travel to the destination floor encoded on his or her card then they may register an alternative destination floor on one of the touch screen terminals (TST) in the lobby.

CLAIMS

1. A lift control system including means for receiving and for processing calls for lifts from users of the system, in order to allocate lifts for movement to given destinations, said call processing means being adapted to be set selectively to operate according to one of at least two call processing algorithms including a directional collective control algorithm and a destination hall call control algorithm.

2. A system according to Claim 1, wherein said means for receiving calls for lifts includes two alternative sets of manual controls enabling a user to place a call by indicating, on the one hand, a required direction of travel, or, on the other hand, a destination served by a lift, and wherein said lift control system includes means responsive to the selected setting of said call processing means for indicating to a user that set of manual controls that is available for use.

3. A system according to Claim 2, wherein said responsive means includes a software driven user interface associated with said manual controls.

4. A system according to Claim 2 or 3, wherein said manual controls comprise touch responsive areas of video display screens, and said responsive means is arranged to display on corresponding screens, selectively, any one or more of a plurality of video images depicting appropriate touch responsive areas of a video screen.

5. A system according to any one of Claims 1-4,

wherein said call processing means is adapted to be set manually to operate according to a selected one of said call processing algorithms.

6. A system according to any one of Claims 1-5, including means responsive to a given traffic demand for setting said call processing means to operate according to a corresponding call processing algorithm.

7. A system according to Claim 4, or Claim 5 or 6 as appended thereto, wherein said video display screens are supplemented by further video screens providing transom displays and/or in car displays and said system is further adapted to provide, via said video screens, messages or information in response to operation of said manual controls.

8. A system according to any one of Claims 1-7, further including manual control means for controlling operation of said call processing independently of said call receiving means.

9. A system according to Claim 8, as appended to Claim 4, wherein said further manual control means includes means responsive to actuation of touch responsive areas of a said video display screen in a predetermined coded combination.

10. A system according to Claim 8, wherein said further manual control means include a portable hand held remote control means.

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